

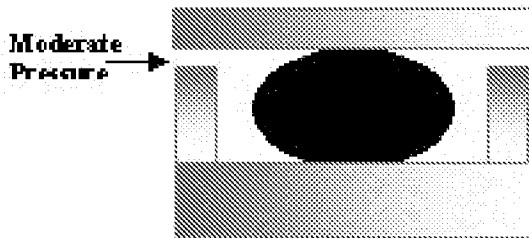
REMARKS

Reconsideration and allowance are respectfully requested.

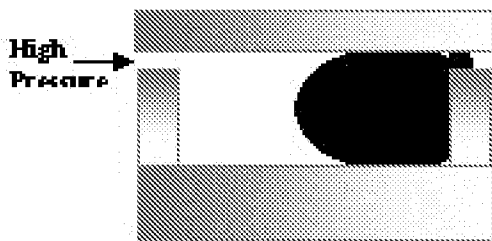
Claim 15 has been modified to include description from claim 18 to better describe and claim the working action described herein. Claim 18, now redundant, is cancelled.

The subject matter of the present invention would neither be anticipated by nor obvious from Voss (5,462,076).

Voss '076 discloses a valve with an o-ring seal in a restrained, radially loaded configuration. In ordinary conditions, the o-ring cross section looks like this:



However, when the fluid pressure is high, the o-ring deforms like this:



(Images from <http://www.toparts.com/Html/ElastomerORing.htm>, a copy of the pertinent part of which is attached.)

In the present invention, the valve is intended to open at high pressure. In such a case, the motion of the valve assembly, together with the deformation of the o-ring seal as shown above, causes acute strain on and sometimes failure of the o-ring. When the valve opens quickly, such as with the sudden application of high fluid pressure, the o-ring may be sheared by the valve opening as the valve opening crosses the o-ring.

Applicant's invention greatly improves on this design by operating in a manner shown in Applicant's Figures 3-5.

When the valve is closed, fluid pressure presses the seal ring radially inward, forming a better seal against the valve piston, without causing any portion of the seal ring to enter the seal gap. (Fig. 3) As the valve opens, the fluid pressure is directed to force the seal ring away from the valve piston, reducing the risk of any part of the seal ring being sheared by the valve opening. (Fig. 4) When the valve closes, fluid pressure is again directed around the seal ring, pressing the ring against the valve piston once again. (Fig. 5)

This operation, disclosed in the specification on pages 10 and 11 with references to figures 3-5, is novel and not disclosed or suggested by Voss. The physical construction of the instant invention which results in this operation is similarly novel.

The subject matter of the present invention as particularly pointed out in Claims 16 and 17 would not be obvious from Voss in view of Farley (5,695,197).

Farley discloses a seal ring much like that used in the present invention. Use of a seal ring as disclosed by Farley in the valve disclosed by Voss would be an improvement, but would not account for the operation discussed above. Mere use of a seal ring is not enough; Applicant

claims the use of a seal ring, together with the geometry of the fluid channels to create the necessary operational characteristics.

The subject matter of the present invention as particularly pointed out in Claims 22, 24, and 25 would not be obvious over Voss in view of Farley and further in view of Albertson (6,290,235).

Albertson teaches shaping the groove to allow fluid flow around the seal ring under certain circumstances. Specifically, Albertson teaches the shaping of seal rings and the grooves in which they are seated to form a sort of one-way valve where backpressure is allowed to dissipate through the seal area but forward pressure is not. Use of this configuration would not improve on Voss any more than Voss is already improved by Farley; relief of backpressure is not an objective of the present invention. Were one to reverse the operation of Albertson and include it in Voss, the result would be a leaky valve as forward pressure would travel around the seal ring as disclosed by Albertson. To contrast the two more clearly: Albertson teaches the travel of fluid around the seal ring and through the seal where the pressure difference in one direction across the seal area is high whereas the instant invention teaches the travel of fluid around the seal ring which presses the seal tighter against the valve piston, creating a more effective seal.

The subject matter of the instant invention as particularly pointed out in Claims 15 and 28-33 would not be obvious over Voss in view of de Launay (4,176,680).

De Launay teaches a top hat shaped body movable in response to pressure against a spring much like the instant invention. De Launay, however, uses an o-ring positioned on the

‘brim’ of the top hat such that when the top hat is pressed against the non-movable valve body (i.e. the valve is closed) the o-ring is compressed axially between the top hat and the non-movable valve body. (De Launay fig. 1) This configuration is inconsistent with Voss and Albertson, which use axially-loaded seals. Furthermore, the application of the principles taught by de Launay, even considering Albertson, Voss, and Farley, would not accomplish the operation disclosed in the present application, nor the benefits of that operation in the form of longer seal lifetimes.

Comments from European Counsel.

Applicant’s European patent attorney has pointed out:

Enclosed we are sending a blue O-ring (current state of technology) and a red, rectangular seal ring (invention).

The blue seal ring has – as common with O-rings – a round cross-section measuring 2millimeters and an inner diameter of 10 millimeters. It must be installed with pre-tension, so that it is pressed against the piston 24 and seals. In Fig. 1 of US 5,462,076 the receiving groove is named 32 and the O-ring is 27.

This type of O-ring is relatively “tight” up to the above-referenced dimensions and throughput volumes. If the throughput volume must be increased during a sudden opening of the valve (rock fall), these types of rings are very quickly deformed and then destroyed (see introduction).

In the search for a solution, the inventor figured that the seal ring should have a wider contact area on the valve piston and somehow should be pressed onto the valve piston beyond the known pre-tensioning during the installation of the O-ring.

The solution is a seal ring that is to be installed without pre-tensioning and which can then be pressed onto the sealing piston through the hydraulic fluid which is pressurized with 300 bar and more – thus no (round) O-ring. At this point it should be pointed out once more that O-rings always feature a round (at best oval) cross-section. Due to the back pressing, the sealing ring in accordance with the invention is pressed against the sealing piston “from behind” and it seals optimally.

We have enclosed such a seal ring (red). It has an interior diameter of 12.8 millimeters and a cross-section of 2.0 x 2.5 millimeters. A pressure limiting valve fitted with it affords significantly higher throughput volumes and in particular a significantly higher operating life.

Even if one would want to interpret fig. 1 of the US 5,462,076 in such a way – even though there are no respective referenced reasons to do so – that the O-ring 27 sits in a larger groove and can be back-pressed, one must account for the fact that it is inserted in a pre-tensioned condition and thus cannot or not sufficiently be moved on the valve piston; it can therefore not be pressed against the sealing piston via the hydraulic fluid. Furthermore, due to the round cross-section, the hydraulic fluid could flow around the O-ring and the valve would leak. The seal ring is deformed so that a protruding edge develops which reaches into the gap between the valve piston and groove and O-ring. This protrusion is cut off during the relocation of the sealing piston and the O-ring is destroyed (see introduction of patent application). The

specialist therefore ascertains that the current state of technology does not help with solving the problem.

Attached hereto is a scanned image of the blue and red rings received from the European attorney in a plastic bag marked Voss Technology Systems GmbH.

By combining all cited references, the operation discussed herein is not achieved. The particular geometry of Applicant's valve as claimed has novel and non-obvious results, and therefore is not anticipated by, nor obvious from, the prior art.

Applicant's invention is novel and is not obvious, and new and non-obvious features of the invention are set forth in the claims.

CONCLUSION

Reconsideration and allowance of all claims are respectfully requested.

Respectfully,

/James C. Wray/

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